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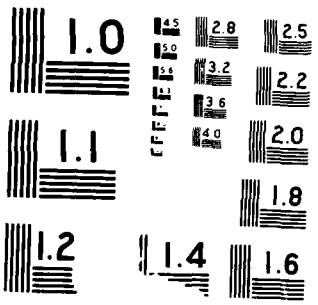
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FINAL REPORT

SMALL AND MESOSCALE PROCESSES IN THE MARGINAL ICE ZONE EXPERIMENT

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CONTRACT START-END DATES: 01 Jan 84 - 31 Dec 87

OBJECTIVES

The primary objective of our research program was to understand the spatial and temporal behavior of the finestructure in the upper ocean of the marginal ice zone and, in particular, to determine the role that internal waves play in determining the behavior of that finestructure. A secondary objective was to provide high quality temperature and salinity profiles from the surface to the bottom in order to supplement the general hydrography of the region and to provide calibration data for other investigators.

TECHNICAL APPROACH

The data sets that we obtained during MIZEX 84 from Polar Queen consisted of 324 CTD records and 12 current meter records. Twenty-eight of these CTD records were casts to the bottom that were taken on a nearly daily basis while the ship was moored to ice floes (Foster, McNamara, Bandurraga and Eckert, 1985). These data were mainly obtained as a service to other investigators; however, we also used these data to calculate the Brunt-Väisälä frequency profiles and the dispersion relations for internal waves. An additional twenty-eight of these CTD records were taken as special calibration casts at the request of other investigators. The remaining 268 CTD records were taken as 8 sets of time series in which the CTD was lowered at evenly spaced time intervals to the same depth in each set (sometimes called yo-yo casts). These CTD time series have been analyzed by examining scatter plots of potential temperature and salinity anomaly pairs and by calculating dropped spectra for displacement and temperature. The current meter data were analyzed by calculating horizontal velocity, temperature and density power spectra and coherencies between current meter pairs. In addition, the vertical velocity was inferred from the density records calculated from the temperature and conductivity time series recorded by the current meters and the vertical profiles of density calculated from CTD casts.

ACCOMPLISHMENTS

The analysis of the CTD time series data has revealed that internal wave energy levels in the marginal ice zone are only slightly lower than those in the open ocean. We also showed that in the marginal ice zone intrusions make temperature spectra an invalid method for determining internal wave activity. A paper on these results has been published (Foster and Eckert, 1987).

The analysis of the current meter records proved to be much more difficult than we originally envisaged; however, we have now obtained some interesting results. The horizontal velocity spectra showed energy levels that were comparable to those predicted by the canonical Garrett-Munk spectra and followed close to a -2 slope within the inertial to buoyancy frequency band. The ratios of anticlockwise to clockwise rotary spectral energy levels were also found to be consistent with internal wave theory. The vertical velocity spectra calculated from the displacement of the density levels were comparable to the Garrett-Munk spectra, but the slope within the inertial to buoyancy frequency band was between -1 and -1.5 instead of the predicted -2 slope. The horizontal currents were very coherent at horizontal displacements up to 550 meters at the inertial frequency, but the coherency fell off rapidly with increasing frequency. The vertical velocities were very coherent at the buoyancy frequency even at the maximum separation of 550 meters. The coherency of vertical velocities was poor at all frequencies for current meters displaced vertically in agreement with the CTD time series observations.

One interesting feature of the vertical velocity spectra was the appearance of bursts of high frequency internal waves for periods up to about a day. These waves were coherent at all the current meters in the array and seemed to be correlated with changes in the local wind field.

We are presently preparing the results of the analysis of the current meter data for publication.

PUBLICATIONS

Foster, T.D., B.S. McNamara, T.M. Bandurraga and E.G. Eckert (1985). Physical Oceanographic Data Marginal Ice Zone Experiment R/V POLAR QUEEN June-July 1984, University of California, Santa Cruz, 166 pp.

Foster, T.D. and E.G. Eckert (1987). Finestructure, Internal Waves and Intrusions in the Marginal Ice Zone of the Greenland Sea, J. Geophys. Res., 92, 6903-6910.

Eckert, E.G. and T.D. Foster (1988). Internal Wave Spectra and Coherencies from the Marginal Ice Zone of the Greenland Sea (in preparation).


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